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Eric M. Dougherty
School of Environment and Natural Resources
The Ohio State University
2021 Coffey Rd
Columbus, OH 43210
Phone: 330-224-4477
E-mail: dougherty.79@osu.edu

Ruffed Grouse Drumming Counts: An Examination of Observer and Roadside Effects

Abstract:

Ruffed grouse (Bonasa umbellus) are the most widely distributed avian game species in North America. The long-term trends, however, have shown a significant decrease in Ohio's populations. Ruffed grouse indices established through annual drumming route surveys show a marked decrease throughout the state. The purpose of this study is to examine methodological practices currently implemented to obtain indices of abundance from roadside drumming counts. The goal is to reduce biases that may arise as the result of observer and roadside influence on grouse drumming behavior.

Three active drumming logs located within the Zaleski State Forest and Waterloo Wildlife Area of southern Ohio were identified and observations of drumming behavior recorded over four-minute periods at distances of 50 to 300 m from the log in the direction that the bird faced. This data was used to examine differences in drumming behavior such as the frequency or interval between drum times, compared to the distance of the observer and nearest road. Analysis of variance, logistic regression, and linear regression were then utilized to examine the effect of these variables on drumming behavior.

While no significant difference was found in regard to distance from roadside, it was discovered that the observer impacted drumming behavior when a calm-down period

was examined at distances of 100 and 50 m. The mean interval for the first four-minute observation period was substantially longer than the second and third at the same distance, thus confirming that the use of a calm-down period is effective in reducing error due to the presence of an observer (Period 1 = 391 seconds, Period 2 = 233, Period 3 = 238). These results indicate that observation of a calm-down period prior to data being recorded could improve survey methods by increasing detection.

INTRODUCTION

The Ruffed Grouse is a game species native to Ohio that is distributed throughout deciduous and coniferous forests of North America but is most abundant in early-successional forests dominated by aspens and poplars (Rusch et al. 2000). Ruffed grouse are an important species that raises revenue through the sale of hunting equipment and licenses that may be used for conservation. This species is sensitive to landscape changes and has been of increasing management concern (Harper et al. 2003). Ruffed grouse have been shown to favor clear-cuts at 4-15 years post harvest (Dessecker et al. 2006). The main limitation typically cited for ruffed grouse populations is maturation or successional stage of forests (Jones et al. 2002). Changes in habitat structure as the result of anthropogenic factors have affected the distribution and abundance of grouse in the state and throughout its range (Ewing 2003). However, there is no minimum amount of contiguous habitat required for ruffed grouse due to their high mobility (Schaffer et al. 1999).

Ruffed grouse are a species sensitive to changes in habitat structure and thus are an indicator of the overall condition of Ohio's forest habitat. Changes in ruffed grouse abundance and distribution within their range are correlated with alterations in the

successional stage or composition of forested areas. By accurately monitoring populations, more informed management decisions may be made on how to harvest forest stands and manage landscapes to provide the most diverse habitat for grouse.

As early as 1945, a technique referred to as roadside drumming counts was applied to determine abundance of grouse by utilizing a spring census (Petraborg et al. 1953). This method of census typically involves an observer stopping at set points along a roadside and listening for signs of grouse drumming for a 4-minute period. Interpreting this data raised several new questions regarding frequency of drumming, radius of audibility, weather effects, and landscape variables. Examination of such biases that could potentially alter population indices may improve grouse management decisions. Two areas of grouse management that have not been studied in detail are the effects of roads and observers on grouse drumming behavior.

The drumming of ruffed grouse is a unique mating ritual. In this process, a solitary male will establish itself at one or more drumming logs and produces a low-pitched reverberating sound. The “drumming” is accomplished by rapidly beating the wings at successive intervals and generating wind currents while the tips of wing feathers contact the drumming log, which generates sound as air currents rush to fill the vacuum created as the wings are flapped (Rusch et al. 2000). Drumming of males peaks in intensity during April in Ohio, depending on conditions, and coincides with the mating season (Ewing 2000). The number of wing beats and duration are variable within and among individuals (Aubin 1972). The direction that the bird faces affects audibility. The ruffed grouse tends to stand perpendicular to the log. Thus logs facing different directions would provide a means of directing sound a particular way (Jones 2002).

The preference for early successional habitat pertains to canopy cover and stem density sufficient to screen avian predators and provide adequate foraging structure (Schaffer 1999). Logs are selected based upon openness in shrub layer, visibility, and canopy cover. The grouse usually selects a log elevated above the surrounding landscape in order to detect approaching predators, rival males, or mates (Hale et al. 1982). Early successional habitat lends itself to freedom of movement for small species while larger predatory species are hindered both in speed and stealth, thus approaching a drumming grouse without being seen or heard is more difficult in this environment.

Possibly the most problematic factor in monitoring ruffed grouse populations is detectability, specifically range of audibility as pertaining to male drumming. There is significant variation in data and estimates of detection range and it is decidedly variable depending upon habitat type, topography, direction, weather, and even among birds. Archibald et al. (1953) attempted to calculate this range in Minnesota by having one researcher stand in sight of the bird and raise his hand every time it drummed. Another researcher simultaneously walked away from the bird and indicated whether or not they could still hear the grouse each time the bird drummed. Under average conditions a distance of 201 m auditory detection was the most accurate, and 302 m under ideal conditions. Sumanik (1966) contended this conclusion and estimated the audible range to vary from 201 m to 402 m or more depending on conditions.

Archibald (1970) further examined audible range in relation to directional differences. This study used a camera and four microphones suspended and placed evenly around the drumming log with the “front” oriented in the direction which the drumming bird typically faced. This study concluded that sound is directed more to the

front of the drumming log with an average intensity of 101.5 dB. The average to the sides and rear were approximately 15 dB and 9 dB less than the front, respectively. Archibald (1974) also noted that birds did circle around repeatedly during this process but generally faced a primary direction with a down-facing slope where an area devoid of leaves and debris would result from the wind currents generated (Archibald 1974).

Drumming counts are conducted during the spring breeding season in areas of management or research concern to obtain an index for regional trends in breeding populations and to estimate fall hunting success specific to an area (Rodgers 1981). Data is collected along a set route or transect where either specific sites or an entire outlined trail are monitored for a given time. This is usually done under favorably calm weather and done early in the day as drumming peak occurs about a half hour before sunrise and continues for around two hours after sunrise (Palmer 1969).

The interval between drumming is variable but is scientifically accepted to be around four minutes (Petraborg 1953). For this reason, spring drumming counts often use an allotted time of four-minutes at each site to observe sounds. This could be a source of inaccuracy as some research shows a marked decrease in the magnitude of sound upon approach of a predator or researcher (Gullion 1967). Recent research has suggested the use of a buffer period after arrival of the researcher, but before data is recorded to account for this effect. This is termed a calm-down period and may last five minutes (Jones 2002).

If road and observer effects influence drumming interval and/or detectability, then this information can be used in making recommendations to improve future data

collection procedures. In order to improve survey methods, it is vital to understand what biases may be associated with population indices.

This study sought to examine three aspects of grouse drumming behavior. The first objective was to examine the audible range of ruffed grouse specific to the study area. This allows for a more accurate representation of what is actually being measured or sampled by drumming surveys. This study also sought to determine if the distance from nearest roadside is correlated in any way to drumming behavior, either interval or frequency. Does traffic or other roadside related features cause a grouse to alter drumming behavior? The effect of an observer was the final component of concern. If an observer enters the area surrounding a grouse, will it impact behavior and if so at what distance?

Study Area:

The area for this study was the 26,827-acre Zaleski State Forest in Southern Ohio and the nearby Waterloo Wildlife Area. Purchase of this land began in 1944. Before that time the forest was selectively cut and portions used for agriculture and grazing. It is located within Vinton and Athens counties with its center at approximately 39.259° N latitude and -82.399° W longitude. Its deep ravines create a rolling landscape, and its acidic soils low in organic matter define this area of unglaciated Ohio. The ravines were created by runoff and erosion of the sandstone and shale soils. This portion of Ohio receives approximately forty inches of rainfall annually (ONDR 1992).

The forests of this region were once composed primarily of oak and hickory, but a shift toward beech and maple stands has occurred particularly in the ravine bottoms (Trani 2001). This is due in part to a lack of fire that is required for regeneration and

clearing of understory that allow these hardwood species to take hold. Recently, increased emphasis and efforts have been made to maintain the integrity and diversity of Ohio's forests. Prescribed burns and responsible forestry practices such as selective and shelter-wood harvest have been implemented in this region to ensure mature hardwood and various successional stages of habitat for wildlife.

Methods:

Three active drumming logs within the study area were located during March of 2008, prior to the peak of breeding season. The three active drumming sites for this study were all located in early successional patches of forest consistent with the ruffed grouse's preferred habitat type. Once found, and active drumming was observed the predominant direction in which the bird faced was determined by orientation of log, examination of leaf litter disturbance, and scat surrounding the log as described by Hale et al. (1982). The direction was noted and measurements taken of the surrounding habitat.

A global positioning system was used to mark the log's position and ArcGIS used to calculate the distance to nearest roadside. Marking tape was placed at 300, 200, 100, and 50 m increments perpendicular to the log in the direction of drumming determined to be predominant. A diameter tape was used to measure the circumference of the log and decay was rated on a scale of 1-5 as described by the USDA Forest Services (1979). An angular gauge was used to measure understory cover. Ground cover was categorized into four classes: litter, forbes, grass, and bare ground. These classes were rated using a 0.5 m² daubenmire frame into the following percent cover classes: 1 = 0-5%, 2 = 6-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-95%, 6 = 96-100%. Four readings were taken with a 20 decimeter robel pole in cardinal directions at a distance of 15 meters from the log's

center. A spherical densiometer was used to measure canopy cover at the bird's drumming position and a clinometer was used to determine slope in two directions perpendicular to the log.

Observation began in April 2008 coinciding with the peak of mating season. All recordings were taken between sunrise and approximately 2 hours after in compliance with the times for most consistent drumming (Palmer 1969). Only fair weather days were used for data collection to negate possible weather influences on audibility and thus detectability of drumming grouse. Temperature, cloud cover, and wind conditions were recorded.

At each established site the observer approached from the predetermined direction of drumming and recorded the first distance that drumming was audible. The observer then proceeded to the 300 m data collection point, if not already within 300 m of the log. At both the 300 m and 200 m sites the observer recorded over a four-minute period, and the time was recorded at the start of each audible drumming. At the 100 m and 50 m sites the observer recorded drumming over a twelve-minute interval, which was divided, into three four-minute periods to examine the effect of a calm-down period. If the grouse was still audible at the 50 m point, then the log was approached in an attempt to determine the range in which a grouse will be scared and flee due to observer influence. The closest location at which the grouse was observed drumming was marked and distance recorded.

Interval of drumming was tabulated using the time period between the first recorded audible sign and the start of the next. Analysis of variance was used to examine differences in the mean drumming interval among periods of observation and between points 50 m and 100 m from the drumming log and the interaction of

observation period and distance. The relationship between distance from roadside and mean interval was examined through a linear regression model using intervals calculated from the 50 m and 100 m points.

Logistic regression was used to test for a relationship between the probability of grouse detection and both period of detection and distance of observer from grouse. To account for repeat measures at each log, log was included as a random effect.

Results:

The habitat was consistent with a forest in the 5-15 year post harvest successional stage (Table 1). The predominant ground cover was litter comprised of leaves and small twigs. The mean slope above the drumming log was 15° and the mean slope below 20° with all logs located toward the upper aspect and the predominant direction of drumming downward. However, there was substantial differentiation in both the diameter and decay stage of the drumming log.

The mean distance at which actively drumming grouse were audible was found to be 253 m (SE = 21) and the mean drumming interval for all three sites at all distances was 287 seconds (SE = 43). The mean distance at which a grouse was last heard drumming was 62 m (SE = 14).

Mean drumming interval differed among observation periods at 100 m and 50 m distances (Period 1 = 391 seconds, SE = 64.8; Period 2 = 233, SE = 16.3; Period 3 = 238, SE = 18.2; $F = 4.59$, $p = 0.039$) (Figure 1, Figure 2). Mean drumming interval at the 50 m (294 seconds, SE = 56.5) and 100 m (278 seconds, SE = 30.9) locations were not different ($F = 0.04$, $p = 0.833$). The interaction between observation period and observer's distance from log was not related to drumming interval ($F = 0.41$, $p = 0.675$).

Distance to nearest road also did not explain differences in drumming interval ($F = 0.03$, $p = 0.858$) (Figure 3).

The probability of detecting a drumming grouse was not related to distance of the observer from the log within the sampled 300 m range (slope = -0.0076, $z = -0.094$, $p = 0.34$) (Figure 4). However, the probability of detection at 100 m was 100%, but only 67% at 50 m. The probability of detecting a drumming grouse was not influenced by observation period relative to the first 4 minutes (Period 2 = -0.47, $z = -0.29$, $p = 0.77$; Period 3 = -0.47, $z = 0.29$, $p = 0.77$).

Discussion:

The results of this study indicate that distance to the nearest roadway from drumming log does not impact grouse drumming behavior. In addition, no correlation was found relating distance of observer to the probability of detection within the audible range of 300 m. The presence of an observer was found to influence the interval of grouse drumming at 50 m and 100 m but did not affect the probability of detection over the entire sampled range of 50 to 300 m.

There are several assumptions that must be addressed concerning the use of intervals as a measurement of grouse drumming frequency. The most paramount of which is that a grouse is assumed to drum at least every four minutes. This has been utilized by the roadside surveys currently conducted, which is why it was also implemented for this study. However, grouse drumming, as discussed previously, is variable among individuals. A grouse tends to have a set pattern of drumming that consists of a short and long interval with variation in duration as well (Palmer 1969).

The results of this study show that use of this four-minute interval was relatively effective at detecting a grouse drum. At each of the three sites at both the 100 m and 50 m data collection points if the grouse was actively drumming, then it was observed in the allotted four-minute period. The reason for lower probability of detection at the 50 m point was likely a result of the grouse at site 3 leaving the log after detecting the observer. The habitat data for these sites is consistent with a dense understory and would have made it more difficult for an observer to approach without being detected by the grouse. Further, the detection probability was not found to have a relationship to distance of observer through logistic regression.

The mean interval was not different between the 100 m and the 50 m points indicating that the distance of the observer did not impact behavior. However, the approach before the first period at these sites was significant in altering behavior by increasing the interval immediately following the movement of the observer. A consistent drumming interval resumed in both period 2 and 3 at these sites, which had no significant difference. These findings confirm that the use of a calm-down period could improve detection.

While the analysis of calm-down period showed a significant relationship it must be considered that other factors may have affected the outcome. In order to affirm that the calm-down period was the explanatory variable responsible for the variation in drumming interval, it must be assumed that the observer was able to detect the bird not only while stationary at a data point but also while moving. Because of outside noise created by moving through the early successional habitat of this species, it is possible that a grouse could have drummed and not been heard while the observer approached the data

collection points. This could be corrected for if a second observer was present and within audible range to verify all drumming incidences.

The use of a calm-down period is warranted if the observer is the cause of the change in drumming pattern and is not so close as to scare the bird into fleeing before data recording begins. This explanation considers the cause of change in behavior to be that the grouse heard the observer approaching and stopped drumming so as not to give its position away to a potential threat. Once the threat had subsided, a normal drumming pattern resumed.

Management Implications:

Roadside surveys are the primary source of avian population trend information in North America, but have biases integrated that change over time (Berton et al. 2007). While roadside surveys can be useful and require far less study effort than alternative methods, they may not be accurate if implementation is not carefully monitored.

The results of this study show that the methods used to collect data can be improved. Observation of a calm-down period prior to data collection can increase the effectiveness of roadside surveys because the shorter the interval of drumming the more likely that the observer will hear a grouse within the allotted four-minute collection time. Further, this study verified that the use of a four-minute window of observation is accurate for ruffed grouse within 100 m after a four-minute calm-down period.

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Table 1. Habitat data for three study sites in the Zaleski State Forest and Waterloo Wildlife Area located in southeastern Ohio.

Site	% Canopy		Slope		Angular				Bare		Distance Road (m)
	Cover	Robel ^a	Up	Down	DBH ^b	Decay ^c	Guage ^d	Litter	Grass/Forbs	Ground	
1	61	7.3	n/a	17	22.6	5	6	6	1	0	862
2	55	6.5	21	19	42.9	3	10	6	0	0	1151
3	64	7	9	24	56.6	4	11	5	1	1	129

^a Robel pole reading on 20 point scale.

^b Measurement of circumference in cm.

^c Decay rated 1-5 with 1 being least decayed and 5 being most.

^d Angular guage readings utalizing the 10 parameter.

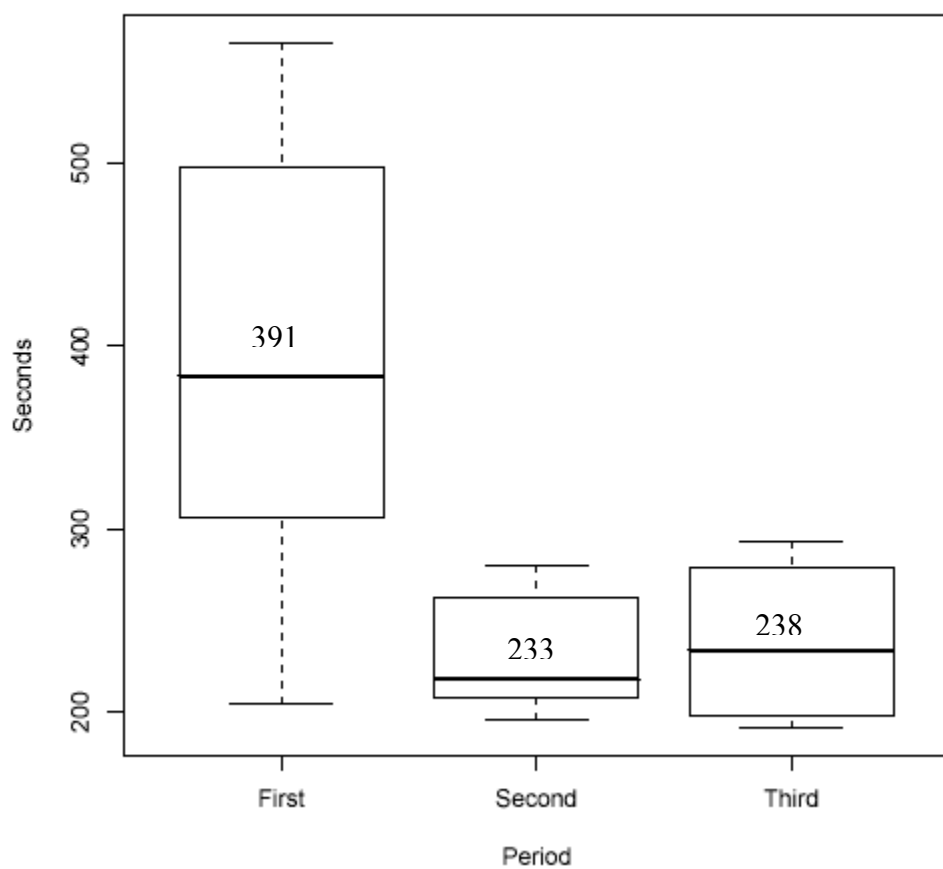


Figure 1. Mean drumming intervals for ruffed grouse at three sites divided into three 4-minute periods at distances of 100 m and 50 m. Data collected during May 2008 in southern Ohio.

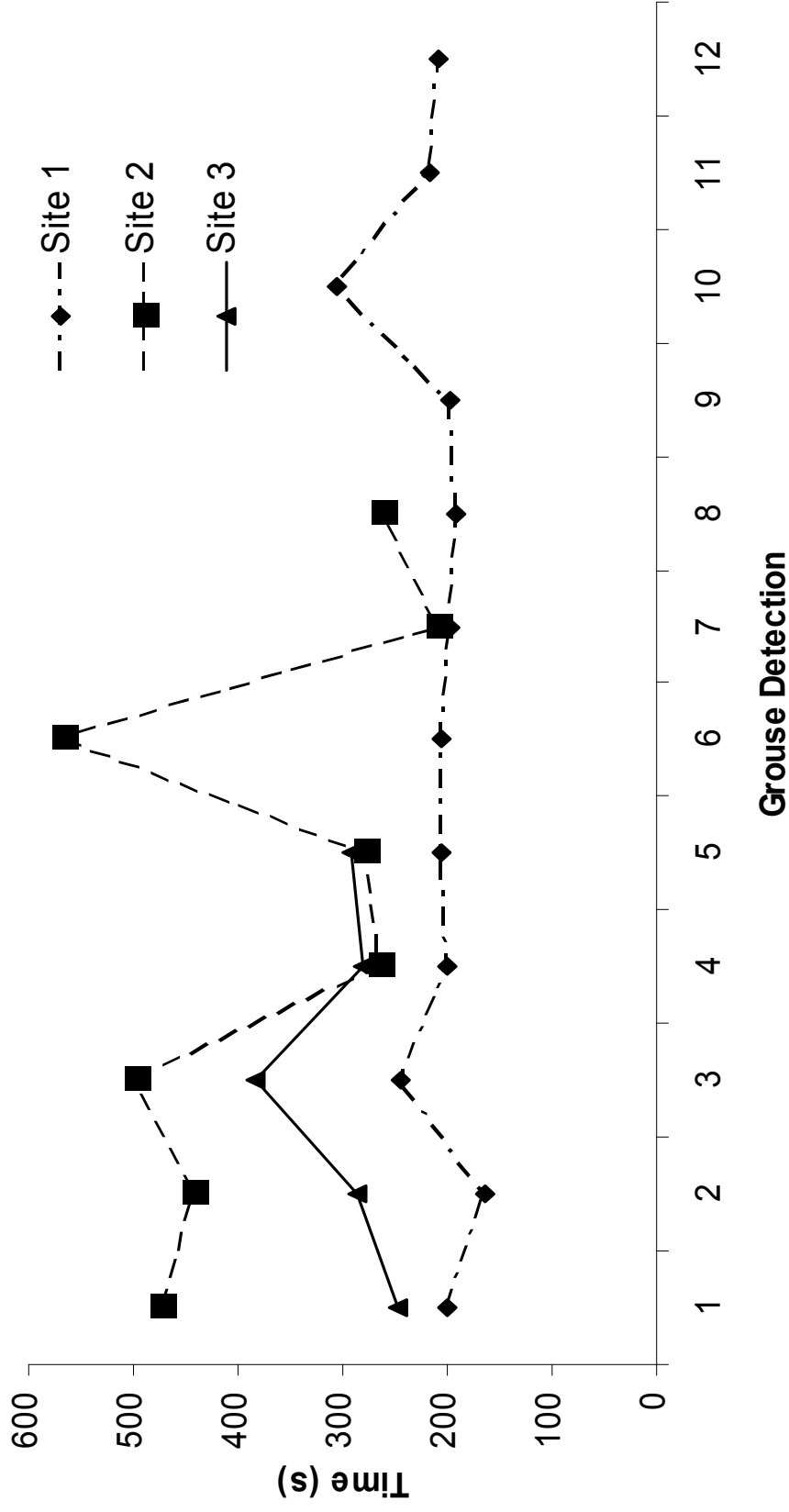


Figure 2. Grouse detection versus duration of drumming interval. Each site represents an individual grouse at one drumming log location. Detection indicates the interval from the first audible sign to the start of the next drumming incident. Distance of observer was variable among and between sites for each detection. Data was collected during spring of 2008 in southern Ohio.

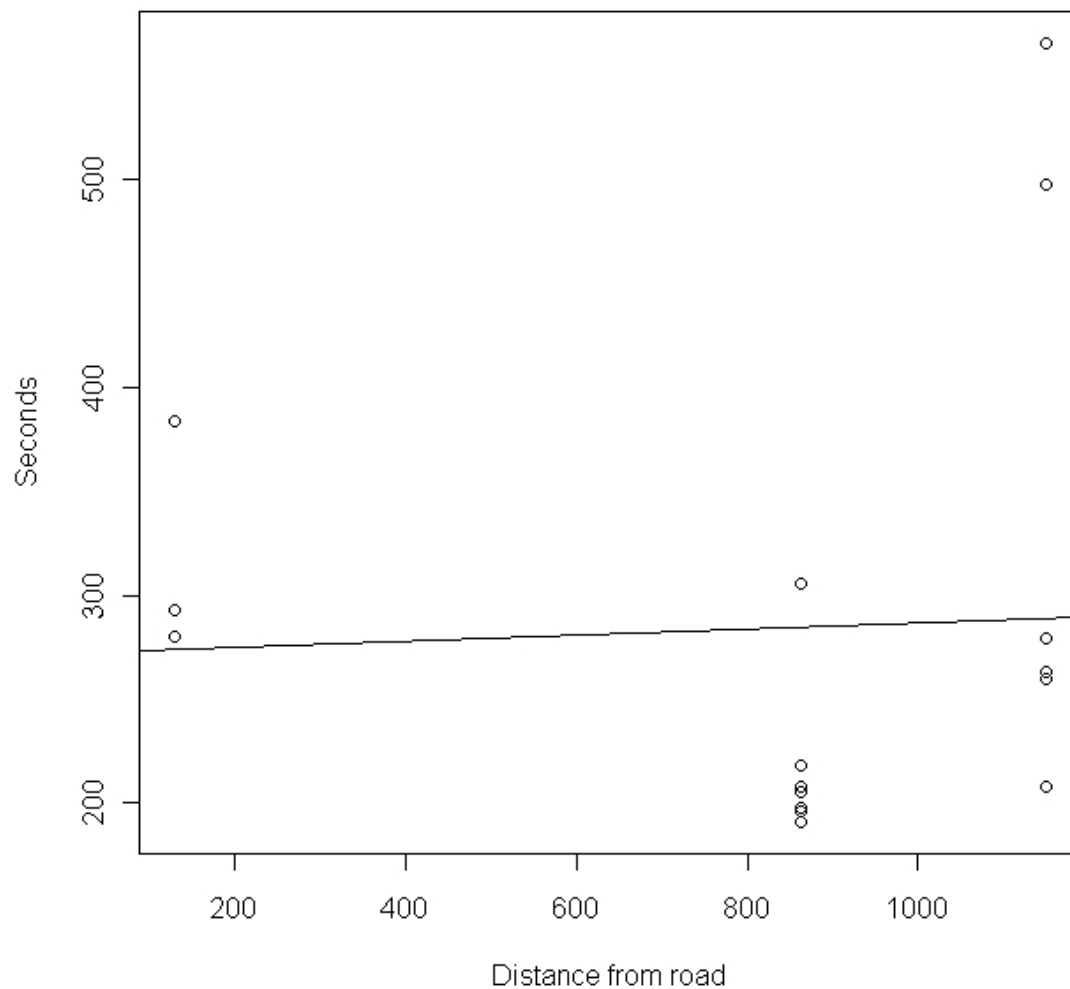


Figure 3. Ruffed grouse drumming intervals versus distance to nearest roadside for three locations in southern Ohio during spring 2008. Roads were categorized based upon level of use negating park trails only open to seasonal traffic.

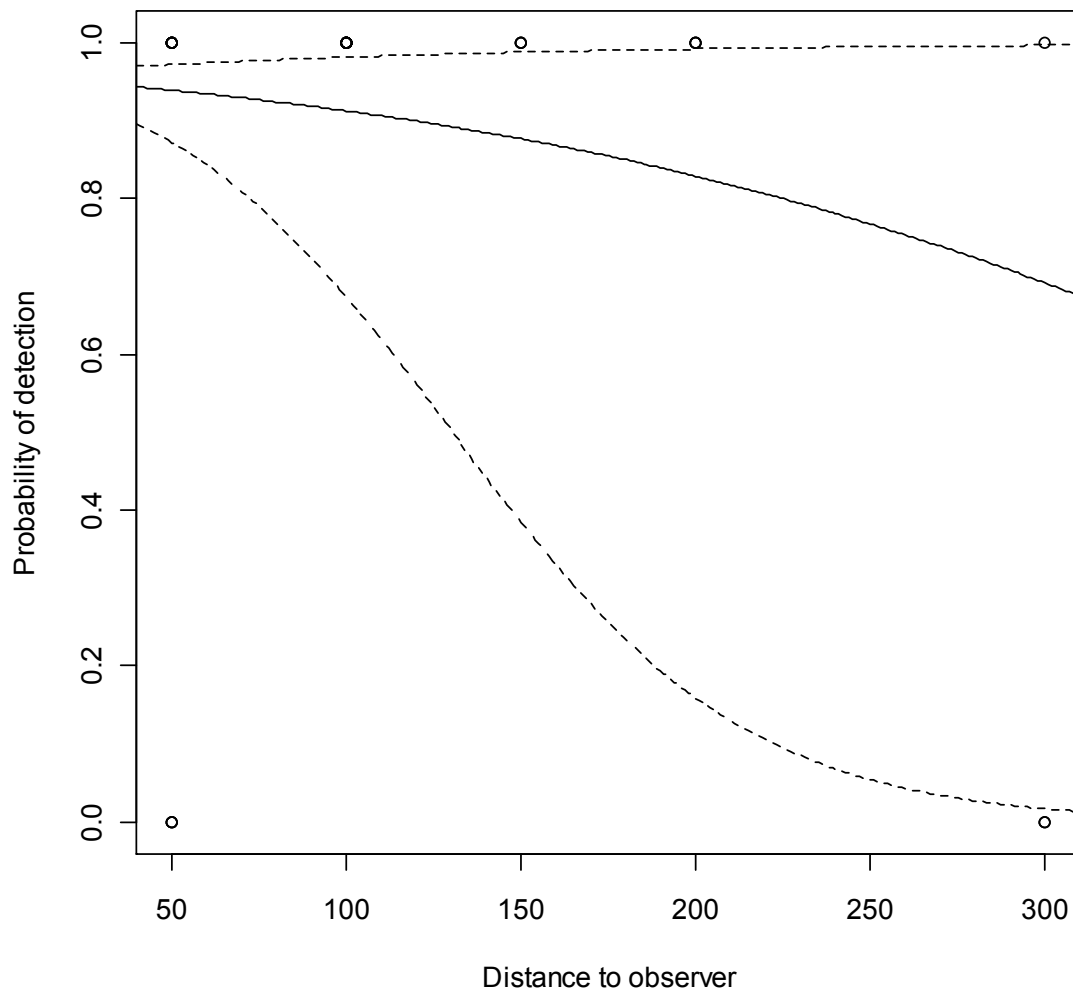


Figure 4. Probability of detecting a ruffed grouse as a function of distance from observer. Points represent individual grouse drumming occurrences at three sites as a binomial variable. Best fit line from logistic regression shown with 95% confidence intervals. Data was collected during spring 2008 in southern Ohio.